Remote Exploration and Experimentation Project

Applications Development for a Parallel COTS Spaceborne Computer

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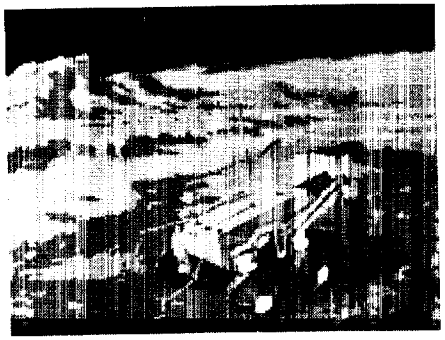
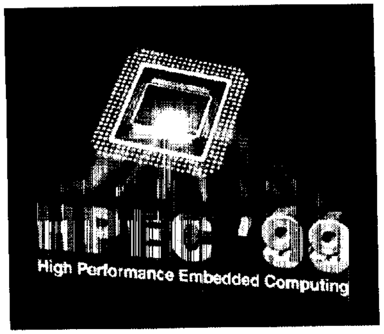
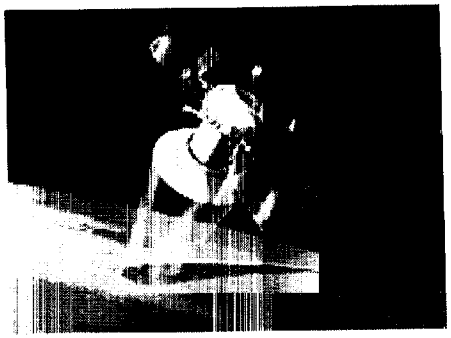


Autonomous Vehicles





High Data Rate Instruments

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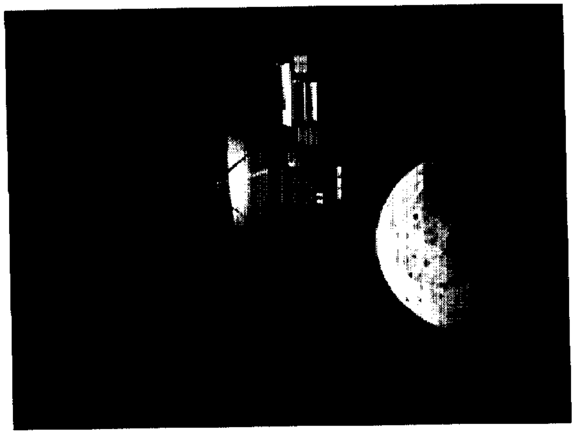
Remote Exploration and Experimentation Project

REE Vision

Move Earth-based Scalable Supercomputing Technology into Space



Background

- Funded by Office of Space Science (Code S) as part of NASA's High Performance Computing and Communications Program
- Started in FY1996

REE Impact on NASA and DOD Missions by FY03

Faster -	Fly State-of-the-Art Commercial Computing Technologies within 18 months of availability on the ground
Better -	Onboard computer operating at > 300MOPS/watt scalable to mission requirements *(> 100x Mars Pathfinder power performance)*
Cheaper -	No high cost radiation hardened processors or special purpose architectures

Objectives

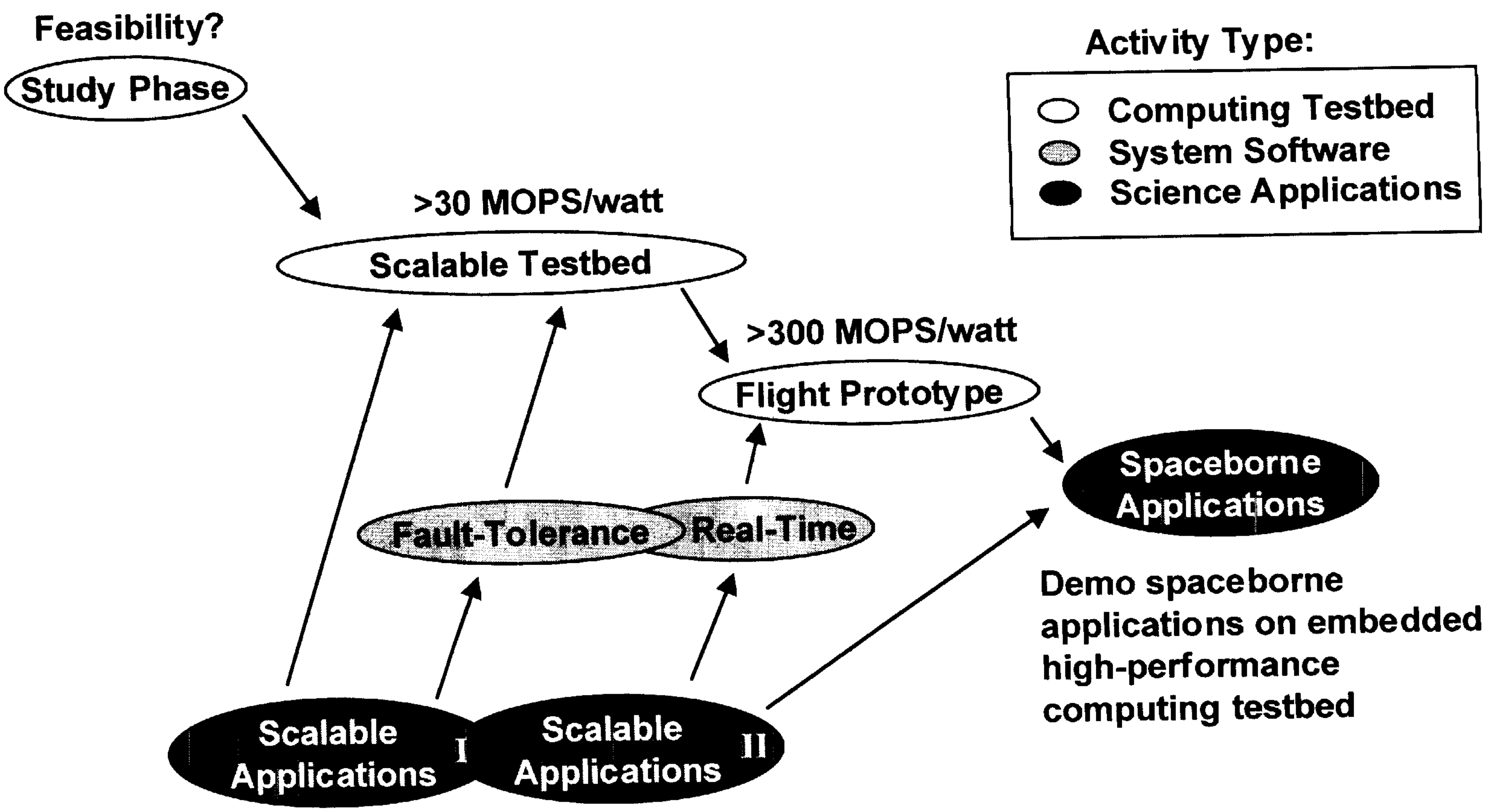
- High Power Performance:
  - Obtain power efficiencies of 300-1000 MOPS per watt
  - Develop an architecture that scales to 100 watts (depending on mission needs)
- Fault-tolerance through system software:
  - Enable reliable operation for 10 years and more (tolerate transient as well as permanent errors)
  - Using commercially available or derived components
  - Includes application services (such as Algorithm-Based Fault Tolerance)
- New spaceborne applications:
  - Run in embedded high-performance computers
  - Return analysis results to the earth; not just raw data

Computational Testbeds

System Software

Science Applications

Overview



Demo spaceborne applications on embedded high-performance computing testbed

REE Implementation

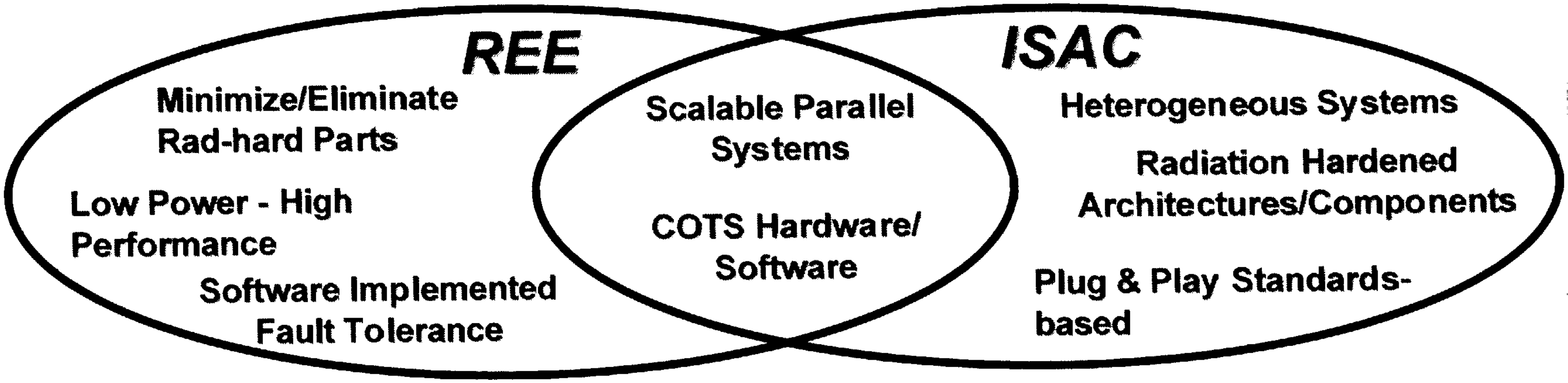
- Use COTS hardware and software to the maximum extent possible
  - Assume that memory supports EDAC
  - Assume hardware detection of “standard” exceptions, but assume that some faults will go undetected
  - Fault tolerance achieved through software
- Keep overhead low
  - Emphasize techniques which do not require replication
- Maintain architecture independence
  - Design should not be tied to any particular hardware architecture
- “95%” rule
  - System does not have to be continuously available
  - Reset is acceptable recovery technique
- Target large applications, both parallel and distributed
  - Gigabytes of memory, gigaflops of processing
  - Scalable with high efficiency
  - Static load balancing sufficient

Current Partnerships

USAF Phillips Lab

Improved Space Architecture Concepts (ISAC)

- Inter-program coordination on a regular basis
- Joint participation on technical reviews and procurement actions
- Technical interactions to avoid duplicate investments and identify possibilities for joint investment



REE

Minimize/Eliminate Rad-hard Parts

Low Power - High Performance

Software Implemented Fault Tolerance

Scalable Parallel Systems

COTS Hardware/ Software

ISAC

Heterogeneous Systems

Radiation Hardened Architectures/Components

Plug & Play Standards-based